APRIL/MAY 2023

# GPH22/DPH22 — ELECTROMAGNETIC THEORY

Time : Three hours Maximum : 75 marks

## SECTION A — (10 × 2 = 20 marks)

Answer ALL the questions.

1. Write the relation between electric field and electrostatic potential.

2. Define Polarizability.

3. Write down the Biot-Savart's law for volume current density J (r') in integral form.

4. State Ampere circuital law in differential form.

5. Write Maxwell's equations in free space.

6. What is Gauge invariance?

7. What are retarded potentials?

8. Define radiation resistance.

9. List some important characteristics of electromagnetic waves propagating in a conducting medium.

10. What is the smallest wavelength that can propagate in a rectangular wave guide of dimension $a \times b$.

SECTION B — (5 × 5 = 25 marks)

Answer ALL the questions.

11. (a) Solve Laplace's equation in Cartesian coordinates.

Or

(b) Derive an expression electrostatic energy in the presence of a dielectric.

12. (a) Using Ampere's circuital law, find the magnetic induction B at a point inside and outside the solenoid carrying current.

Or

(b) What are magnetic scalar and vector potentials? Discuss their characteristics.

13. (a) Explain the importance of Maxwell's displacement current.

Or

(b) Express the Lorentz force in terms of electromagnetic potentials.

14. (a) Discuss the theory of oscillating electric dipolar.

Or

(b) Write short notes on antenna arrays.

15. (a) Derive the equation for plane electromagnetic waves in free space.

Or

(b) Explain wave propagation in a rectangular waveguide.

SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Discuss the theory of dielectric sphere in a uniform electric field.

17. Deduce an expression for Biot-Savart law and hence derive an expression for the magnetic induction at a distance from an infinitely long straight conductor carrying current.

18. State and derive Poynting theorem. Explain the meaning of various terms involved in it.

19. Derive an expression for radiation from a small current element.

20. Derive Fresnel formulae for the reflected and transmitted intensities. Discuss some important consequences of these formulae.

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